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VARIATION IN *ERYTHRANTHE CORDATA* (PHRYMACEAE) IN ARIZONA

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ABSTRACT

Plants of *Erythranthe cordata* vary greatly in size but are consistently distinguished from *E. guttata* sensu stricto in their small corollas, autogamous breeding, and lack of rhizomes. Aspects of size variability and vegetative and floral morphology in *E. cordata* are shown in photos of collections from the state of Arizona.

Erythranthe cordata (Greene) Nesom of the southwestern USA and adjacent Mexico (Fig. 1) has often been misidentified as *E. guttata* (Fischer ex DC.) Nesom within an inclusive, polymorphic concept of the latter, but *E. cordata* is distinct in its lack of rhizomes and its autogamous flowers. A difference in chromosome number (x = 15 in *E. cordata* vs. x = 14 in *E. guttata*) points to their evolutionary distinction. Recent study in the ASU herbarium has occasioned this overview of *E. cordata* as it occurs in Arizona, with the aim of clarifying its identity and its distinction from *E. guttata*.

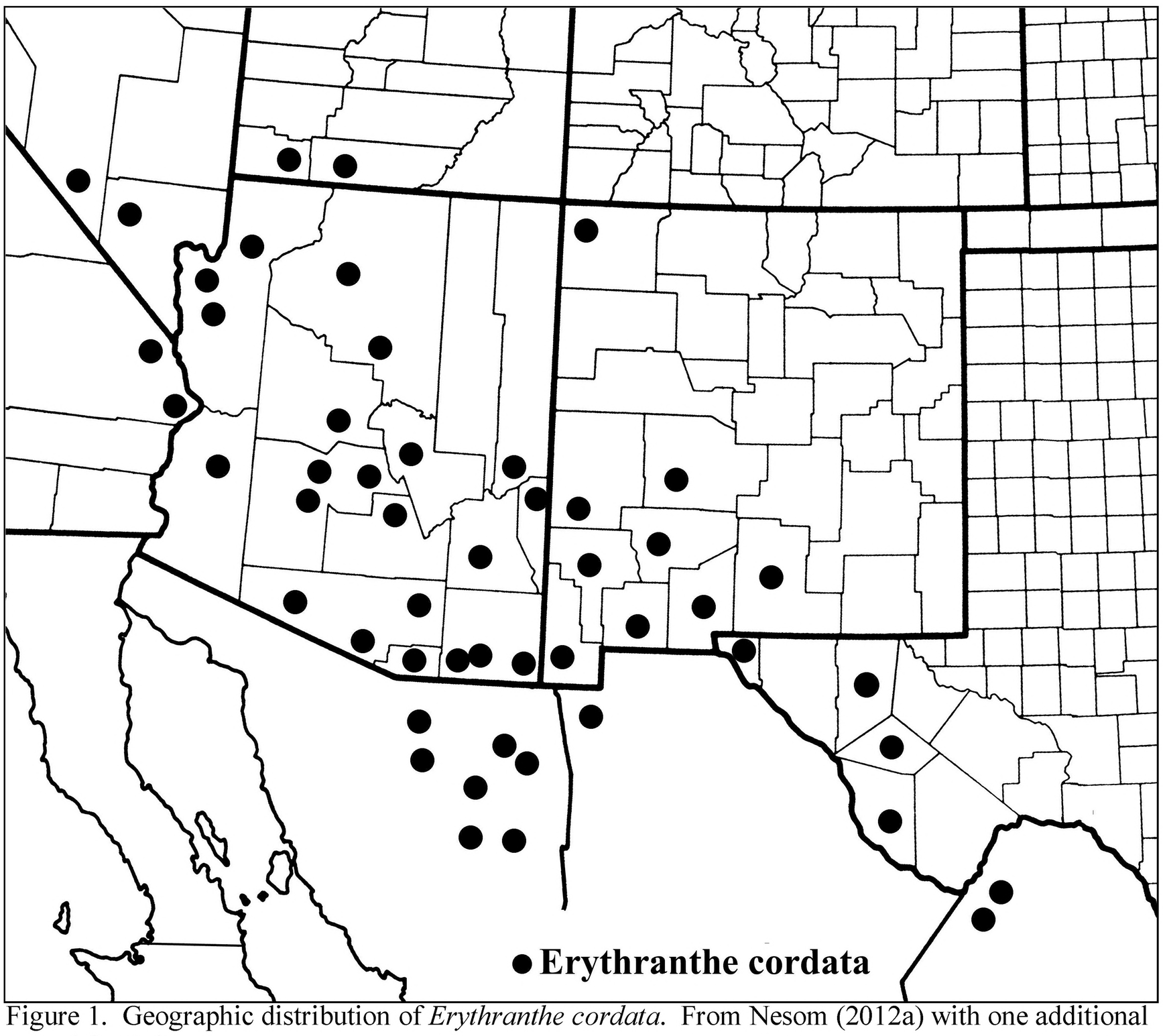

Figure 1. Geographic distribution of *Erythranthe cordata*. From Nesom (2012a) with one additional record for Arizona.

Within *Erythranthe* sect. *Simiola*, *E. cordata* has been regarded as a member of the "*E. arvensis* group" — *E. cordata* plus the *E. arvensis* complex, including *E. brachystylis* and *E. charlestonensis* — each of which is annual (without rhizomes but sometimes with adventitious roots at lower nodes) and produces autogamous flowers (often with small, obviously cleistogamous corollas) mostly produced from distal nodes (Nesom 2012a, 2014a and b). Whether the similar reduced floral features and associated biology in *E. cordata* and *E. arvensis* are strictly homologous or independently evolved probably will be determined by molecular comparisons.

Erythranthe cordata and *E. arvensis* are essentially allopatric, the latter occurring mostly in more northern regions and not documented as a member of the Arizona flora. Typical *E. guttata*, however, occurs widely in Arizona and is distinguished from *E. cordata* by the following contrasts.

1. Rhizomatous; corolla tubes (10–)12–20(–26) mm, exserted 3–5 beyond calyx margin, limb expanded 12–24(–25) mm (pressed); styles 15–20 mm, exserted 6–9 mm beyond fruiting calyx margin; stigma above level of anthers (herkogamous), reproduction allogamous; chromosome numbers $2n = 28, 56$ (x = 14) ..... **Erythranthe guttata**

1. Without rhizomes, fibrous-rooted; corolla tubes 5–14 mm, exserted 1–3 mm beyond calyx margin, limb expanded 9–14 mm (pressed); styles 7–10 mm, exserted 1–3 beyond fruiting calyx margin; stigma at same level as anthers (plesiogamous), reproduction autogamous; chromosome number $2n = 60$ (x = 15) ..... **Erythranthe cordata**

Even if basal parts are not available and corollas have been shed, contrasts in style length provide an effective distinction. In *E. cordata*, the persistent style is short-exserted from the calyx, reflecting the short corolla tube and plesiogamous arrangement of stigma and anthers (Nesom 2012b). In *E. guttata*, the persistent style is longer, reflecting the longer corolla tube and herkogamous arrangement of stigma and anthers.

Figure 1. *Erythranthe cordata*. Relatively large corolla of autogamous flower, short-tubed with throat closed and stigma and anthers within the tube. Cochise Co., Arizona, San Pedro Riparian National Conservation Area, 13 Apr 2002, *Makings 943*, ASU. Photo by Liz Makings. See Figure 2.

Figure 2. *Erythranthe cordata.* Cochise Co., Arizona, San Pedro Riparian National Conservation Area, 13 Apr 2002, *Makings 943*, ASU. Arrows point to small corollas and short styles. Photo mounted on sheet and in Figure 1 is from the same population.

Plants of *Erythranthe cordata* are highly variable in size — from tiny fibrous-rooted plants with nearly filiform stems to much larger individuals with fistulose stems adventitiously rooting at proximal nodes. Label comments for a collection of *E. cordata* from Kane Co., Utah (*Reveal 819*), are representative of this variation: "This population is exceedingly variable as the plants range from less than 1 cm high to over 8 dm high; growing both in seeps where the plants are large to sandy flats along the stream where the plants are 1-4 dm high, to grassy flats where the same plants were as small as 1 cm."

Figure 3. *Erythranthe cordata*. Maricopa Co., Arizona, Lake Pleasant Regional Park, 12 Mar 1967, *Lehto 7750*, ASU. Corollas are 8–15 mm long, the tubes 5–8 mm.

The collections *Erythranthe cordata* shown below are arranged generally by increasing size of plants. Figures 4-6 show strictly fibrous-rooted plants; Figures 7-9 show increasingly larger plants with adventitiously rooting lower stems.

Erythranthe guttata (D.C.) G. L. Nesom

DET. BY: E.P. JOHNSON DATE: 12 Dec 2013
NORTHERN ARIZONA UNIVERSITY (ASC)

Mimulus guttatus DC.

Det. Kathleen C. Rice (ASU) (DJF) 2009

PLANTS OF ARIZONA
Arizona State University

ASU Vascular Plant Herbarium
Specimen Image Number
ASU0063824

Mimulus nastus Greene
Gila County: Tonto National Forest
Superstition Wilderness Area. Tony Ranch Trailhead.

Associated with Platanus wrightii, Quercus turbinella,
and Arctostaphylos pungens.
N-facing slope. Annual herb. Flower yellow.
ca. 4000 ft.

Kathleen C. Rice 564 14 Jun. 1991
With G.J. Imdorf

ASU
189858

Figure 4. *Erythranthe cordata*. Gila Co., Arizona, 14 Jun 1991, *Rice 564*, ASU. Smallest plants are ca. 3 cm tall.

Figure 5. *Erythranthe cordata*. Gila Co., Arizona, 3 May 1993, *Christy 1443*, ASU. Plants range from 4 to 20 cm tall.

Arizona State University (ASU)
269791
Vascular Plant Herbarium
Specimen entered in ASU Database
ASU
0 1 2 3 4 5 6 7 8 9 10
cm
Copyright reserved
Plants of Arizona
Scrophulariaceae
Mimulus guttatus DC.
USA. Arizona. Gila. Mt. Ord; Slate Creek upper, just off Hwy 87 approx 1 mile S of old Slate Creek Rd (FS 26?). In creekbed.
UTM12S 461912E 3753649N
Elevation 5727ft. 1745m.
Habitat: Very sandy/rocky creekbed with evidence of high flow events
Assoc. spp: Veronica anagallis-aquatica, Herniaria cinerea, Cynodon dactylon, Acacia greggii, Cryptantha, Platanus wrightii, Calliandra eriophylla, Mimulus rubellus
Notes: Medium specimen of M. guttatus; Flowers yellow; annual; stems squarish
Theresa Price 806
21 April 2007
with: Kelly Steele
Arizona State University Herbarium (ASU)
ASU Vascular Plant Herbarium
Specimen Image Number
ASU0087129

Figure 6. *Erythranthe cordata*. Gila Co., Arizona, 21 Apr 2007, *Price 806*, ASU. Larger plant ca. 25 cm tall.

Figure 7. *Erythranthe cordata*. Cochise Co., Arizona, 19 Mar 1975, *Reeves R2418*, ASU. Upper plants decumbent at base and producing adventitious roots.

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ASU
PLANTS OF THE SANTA TERESA MOUNTAINS
GRAHAM COUNTY, ARIZONA
ARIZONA STATE UNIVERSITY
Mimulus guttatus DC
Family: Scrophulariaceae
Det. by: J. Jeremy Buegge
Loc: Coronado National Forest
Elev: 4000 ft.
Fisher Canyon. T6S,R21E,sec8,SE,NW. UTM: 12N, 0572934E, 3642905N.
Habitat: Desert grassland. Near wash. S aspect. Gentle slopes. Red granite rock with gravely soil. Water flowing.
Other spp.: Yucca baccata, Baccharis sarothroides, Mulenbergia rigens, Mimosa biuncifera, Juniperus monosperma, Ericameria laricifolia, Gutierrezia, Quercus turb
Notes: Common. Annual (?) often in large clumps. Stolons but no rhizomes. Petals ylw, red spots, throat closed. Calyx ribbed in fruit.
Collector/number: J. Jeremy Buegge - 714
10 April 1999
with: A. Trauth-Nare
ASU Vascular Plant Herbarium
Specimen Image Number
ASU0087128

Figure 8. *Erythranthe cordata*. Graham Co., Arizona, 10 Apr 1999, *Buegge 714*, ASU. Plants apparently with rhizome-like bases but, with reference to the autogamous flowers, these inferred to have begun as above-ground stems. Also see collector's label notes: "Annual (?) often in large clumps. Stolons but no rhizomes."

Figure 9. *Erythranthe cordata*. Maricopa Co., Arizona, 14 Mar 1965, *Lehto 4552*, ASU. Fistulose stems with adventitious roots at nodes.

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cm
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ASU
PLANTS OF ARIZONA
Arizona State University
Mimulus guttatus DC.
Maricopa County: Tonto National Forest..
Along Verde River at mouth of Camp Creek Wash.
FS 20, ca. 3 mi N of Rio Verde Road. 33°46.30'N, 111°39.9'W
Along slopes near river and along wash.
Annual herb near water.
°G. Walters, S. Palmer
L. R. Landrum 9640
With A. Trauth, A. Mejia, R. Puente, °
Fam: Scrop Elev: 1520 ft. Date: 16 Feb 2000
ASU Vascular Plant Herbarium
Specimen Image Number
ASU0087127
PHOENIX FLORA

Figure 10. *Erythranthe cordata*. Maricopa Co., Arizona, 16 Feb 2000, *Landrum 9640*, ASU. Without basal parts but label notes say "Annual herbs." Flowers autogamous.

ACKNOWLEDGEMENTS

I am grateful to the staff at herbarium ASU (Arizona State University) for their hospitality, particularly to Walter Fertig for providing the photos of specimens and to Liz Makings for the photo in Figure 1.

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